

B1 and
bringing the semiconductor wafer into contact with an aqueous treatment agent solution for oxidizing the polished surface by action of the aqueous treatment agent solution; [and]

wherein said aqueous treatment agent solution consists essentially of an oxidizing agent and an alkaline component; and storing the semiconductor wafer in deionized water after contact with the aqueous treatment agent solution.

Please add claim 13 as follows:

C 13. Process according to claim ¹⁴₁, comprising

B2 flushing the treatment agent solution off the semiconductor wafer by using deionized water, after completing the oxidizing.

REMARKS

Reconsideration of this patent application is respectfully requested in view of the foregoing amendments and the following remarks.

The amendments to this patent application are to cancel claim 8 without prejudice and to incorporate the features thereof into claim 1. Thus claim 1 now recites the step of storing the semiconductor wafer in deionized water after contact with the

aqueous treatment agent solution. Also, new dependent claim 13 has been added. Claim 13 recites the step of flushing the treatment agent solution off the semiconductor wafer by using deionized water after completing the oxidizing. Support for this is found on page 6 in lines 8 to 10 of the present Specification.

Claims 1 and 3 to 12 have been rejected under 35 U.S.C. 103 as being unpatentable over the *Lampert U.S. Patent No. 4,692,223* (newly cited) in view of the *Hayashida U.S. Patent No. 5,580,846*.

The present invention is directed to a process for treating a polished semiconductor wafer consisting essentially of the steps of polishing a surface of a semiconductor wafer; immediately after polishing the semiconductor wafer, bringing the semiconductor wafer into contact with an aqueous treatment agent solution for oxidizing the polished surface by action of the aqueous treatment agent solution; wherein the aqueous treatment agent solution consists essentially of an oxidizing agent and an alkaline component; and storing the semiconductor wafer in deionized water after contact with the aqueous treatment agent solution.

The *Lampert U.S. Patent* discloses in column 1, lines 45 to 48 that after polishing silicon wafers, the polishing step is

ended with a treatment in which a silicon dioxide film is produced on the surface of the polished silicon. Then in column 1, lines 58 to 65 it is stated that there may be a purely chemical oxidizing method, or there may be an anodic oxidation method, in which an oxidizing agent or oxidizing agent mixture is added at the end of the polishing step to an alkaline polishing agent flowing into the surface of the workpiece.

In column 3, in lines 27 to 30 of *Lampert*, it is stated that the polished surface achieved during the polishing step may, by means of a coating applied "directly on completion" of a polishing step, be preserved in both one side and two side polishing of silicon wafers. Even though it is stated that the coating is applied "directly on completion", this does not teach or suggest that the treating of the polished surface may in fact occur "immediately" after the polishing step as claimed.

In column 3, in lines 65 to 67 in Example 1 of *Lampert*, it is stated that an alkaline polishing agent based upon silica sol having a pH of about 11.5 is used in the process. In column 4 in Example 1, in lines 14 to 17, it was stated that etching with hydrofluoric acid was utilized. The teaching of an acid etch in *Lampert* is contrary to the claimed use of an alkaline component.

In addition, *Lampert* fails to teach or suggest the step now recited by claim 1, which specifies "storing the semiconductor wafer in deionized water after contact with the aqueous treatment agent solution".

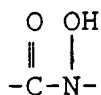
The deficiencies in the teachings of the primary reference are not overcome by the disclosure of the secondary reference to the *Hayashida U.S. Patent*. This patent in column 3, in lines 45 to 55, discloses that surfaces of semiconductors are treated with ultrapure water containing a complexing agent having 3 or more hydroxy amide groups in the molecule of the complexing agent. In column 5, in lines 25 to 35 of *Hayashida* it is stated that a complexing agent is utilized in order to absorb aluminum from the surface of the silicon wafer, wherein such complexing agents as EDTA, CYDTA, TTHA, and NTA, are examples of the complexing agents which form a complex with aluminum.

Hayashida in column 3 in lines 60 to 67 discloses that the process includes having the treatment carried out in the presence of a chelating agent having one or more phosphoric acid groups or a salt thereof in the molecule, an oxidized form thereof, or a polyphosphoric acid or a salt thereof (the chelating agent or an oxidized form thereof and the polyphosphoric acid or a salt thereof are abbreviated as "Fe-removing complexing agents") in

addition to the complexing agent for removing aluminum.

Page 3 of the Office Action has referred to *Hayashida* at column 4 in lines 5 to 9. Here it is stated that there is a surface treating agent for semiconductors which comprises (A) an inorganic or organic alkali, hydrogen peroxide, water, (B) the above-mentioned complexing agent for aluminum and (C) the Fe-removing complexing agent.

The *Hayashida* U.S. Patent No. 5,580,846 in column 1 in lines 5 to 8 discloses treating agents for improving the cleaning of the surfaces of semiconductors and LCDs. In column 3 from line 35 through line 65, this reference discloses that semiconductor wafer surfaces are treated with a treating agent and ultrapure water containing a complexing agent having three or more hydroxyamide groups in the molecule.



It is believed that the amendments to claim 1 which recite "consisting essentially of" exclude the complexing agent (B) having three or more hydroxyamide groups as disclosed in *Hayashida*, which is useful to remove aluminum ions.

Also, *Hayashida* in column 3 lines 60 to 67 discloses that

the chelating agent of Hayashida is to remove absorbed amounts of iron ions from the silicon wafer surface based upon phosphoric acid groups. These chelating agents (C) are also excluded by the recitation of "consisting essentially of".

Also, none of these prior art references teach or suggest polishing a surface of a semiconductor wafer and immediately after this polishing contacting this surface with the aqueous treatment agent solution. Within this aqueous treatment agent solution is an oxidizing agent and an alkaline component. Then the semiconductor wafer is stored in deionized water after contact with the aqueous treatment agent solution. The Table on page 8 of the present specification shows the new and unexpected results according to the process of the invention when compared to the prior art. No prior art reference discloses storing the wafer in deionized water after contact with the aqueous treatment agent solution.

On pages 6 and 7 of the present Specification, it is noted that it is desirable to flush the treatment agent off the semiconductor wafer after the oxidizing treatment is completed, preferably using deionized water. Therefore, the semiconductor wafer is sufficiently protected against undesired attack by a polishing abrasive. The wafer is then stored until it is cleaned

in the usual manner, preferably also by using deionized water. The storage time is preferably 15 to 180 minutes, particularly preferably 15 to 30 minutes. The semiconductor wafer is then cleaned.

The process of the invention was tested on silicon wafers. To do so, test wafers were treated according to the invention immediately after a standard polishing operation and were then stored in deionized water. The wafers were subsequently subjected to final cleaning, were dried and examined for LPDs using a commercially available analysis apparatus. Further silicon wafers, as comparative wafers, were not treated according to the process of the invention immediately after polishing.

By amending claim 1 to include the subject matter of claim 8, claim 1 recites "storing the semiconductor wafer in deionized water after contact with the aqueous treatment agent solution". It is believed that adding the subject matter of claim 8 to claim 1 does clearly distinguish claim 1 over the prior art.

The Table on page 8 of the present Specification provides new and unexpected results for the process of the invention versus the prior art processes. Thus, Test wafers II (invention) have only 96 LPD versus 400 for the Comparative wafers II after 3

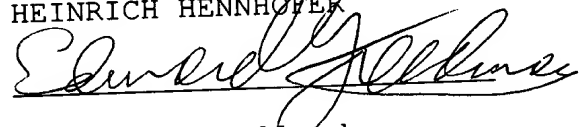
hours. Test wafers III (invention) have only 727 LPD versus 1878 for the Comparative wafers III after 5 hours.

In summary, claim 8 has been canceled without prejudice. New claim 13 has been added. Claim 1 has been amended. In view of these amendments, it is believed that all the claims, and the invention, are patentable over all the prior art references applied by the Patent Examiner under 35 U.S.C. 103. A prompt notification of allowability is respectfully requested.

Respectfully submitted,

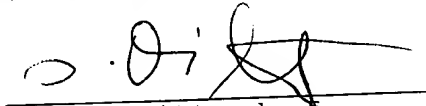
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